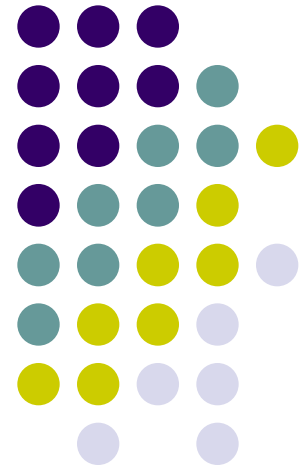
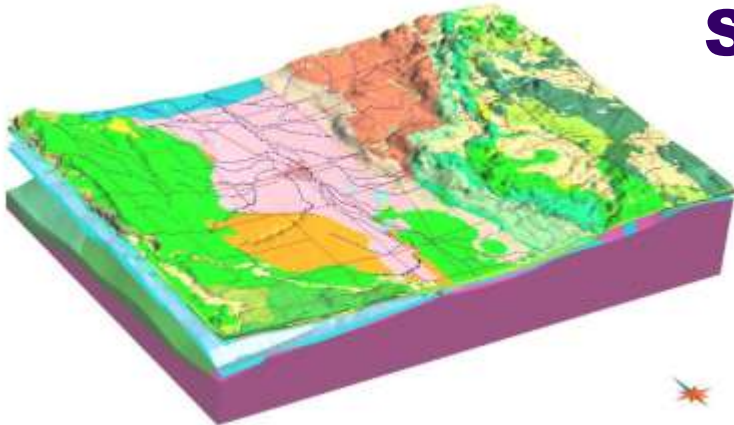


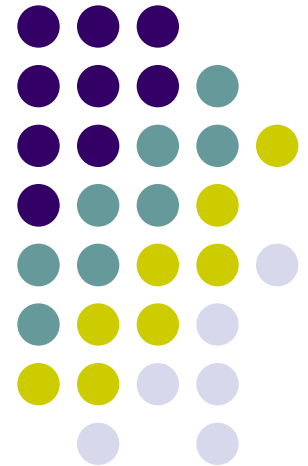
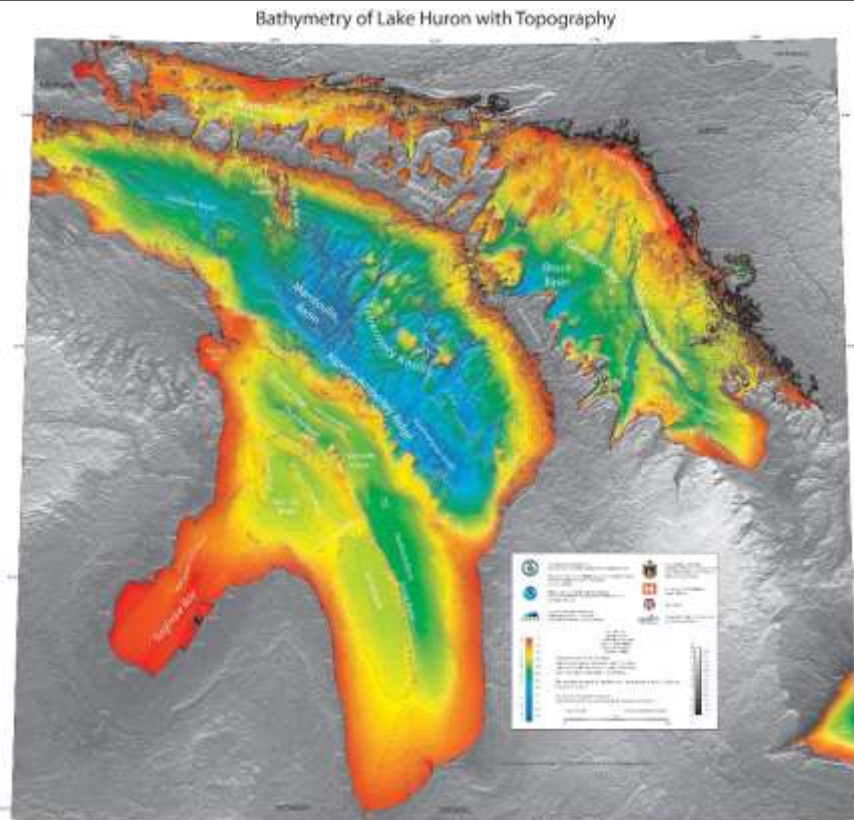
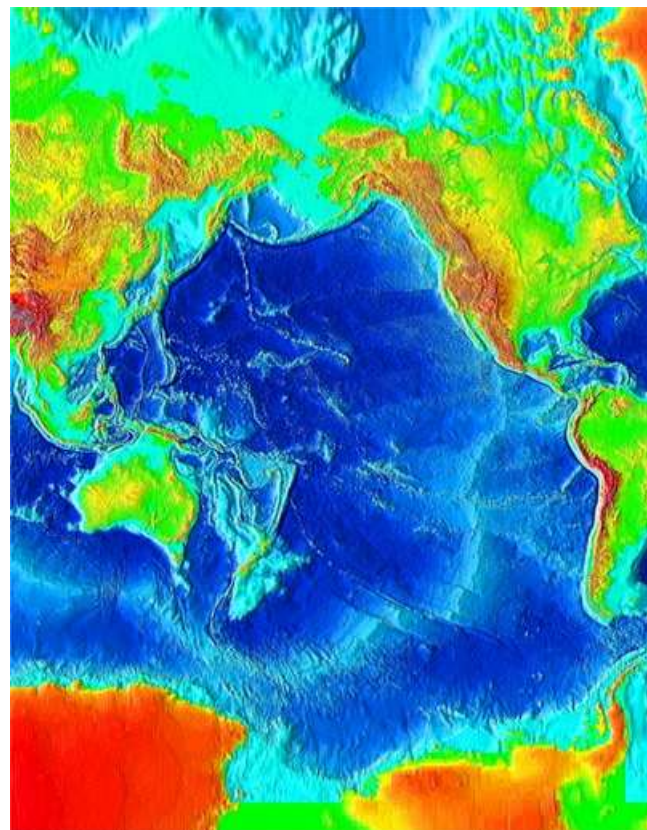
# International coordination of 3D geological mapping

***Harvey Thorleifson Ph.D., P.Geo, D.Sc.***  
***Director, Minnesota Geological Survey***  
***Mapping Chair, Association of American State  
Geologists***

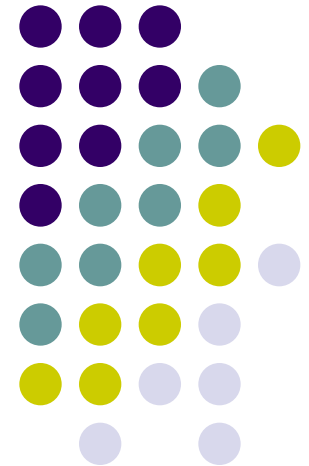
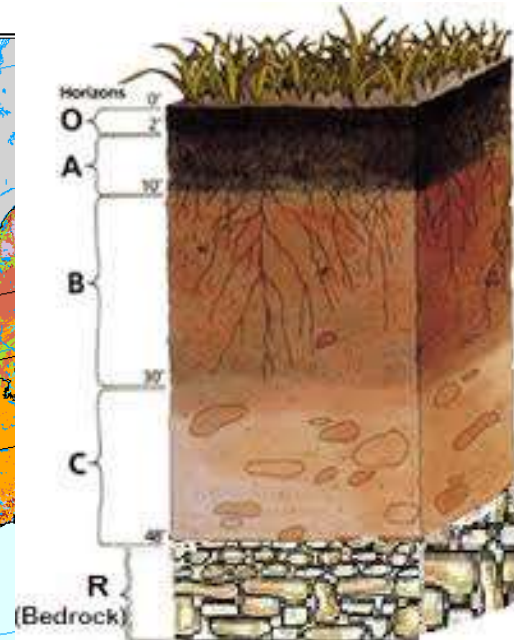
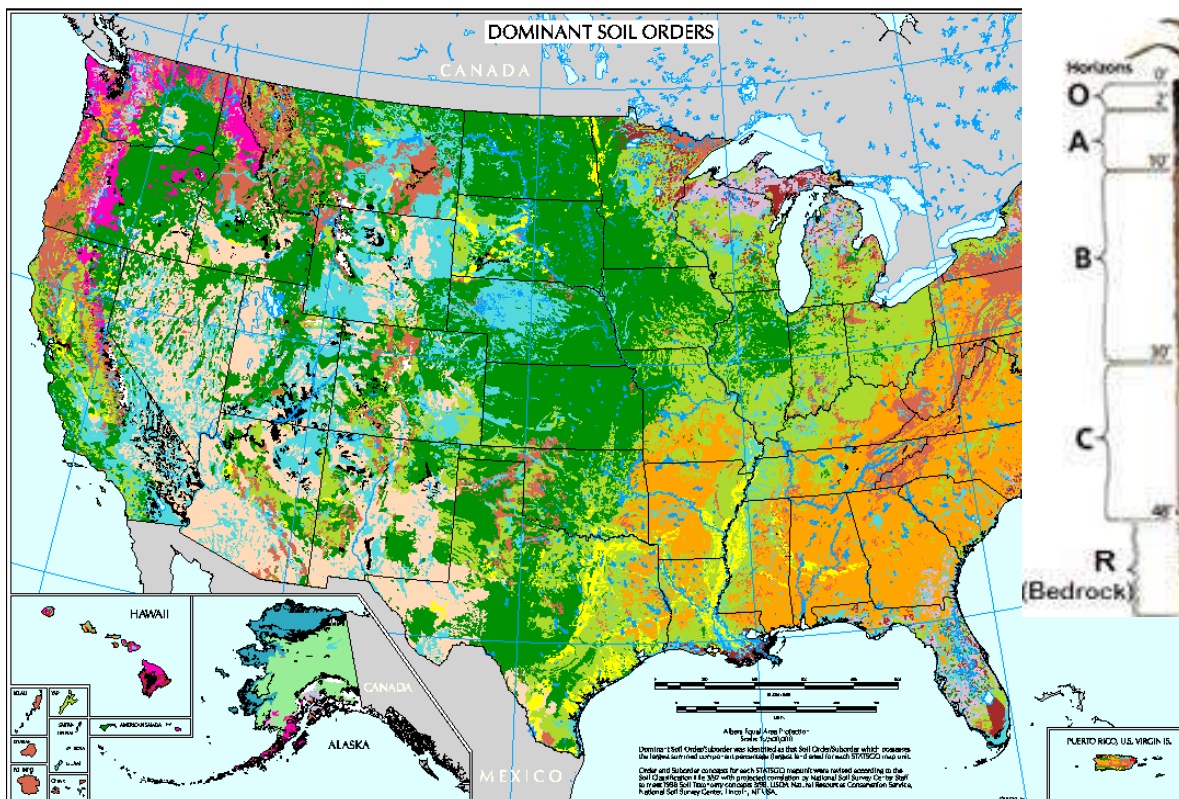
**National Geospatial Advisory Committee**  
**September 1-2, 2015**



# The first subsurface layer is bathymetry

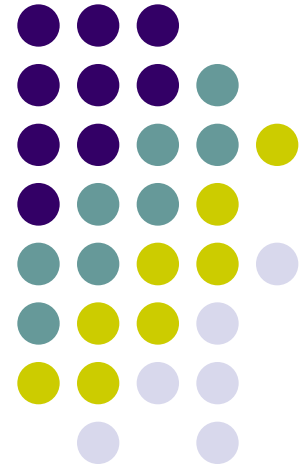
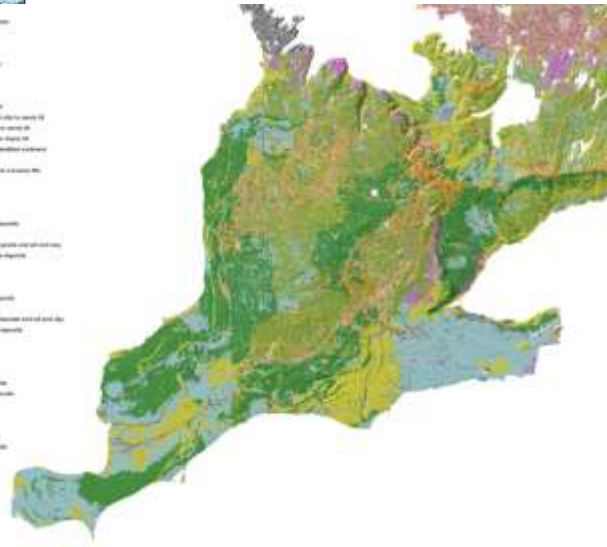
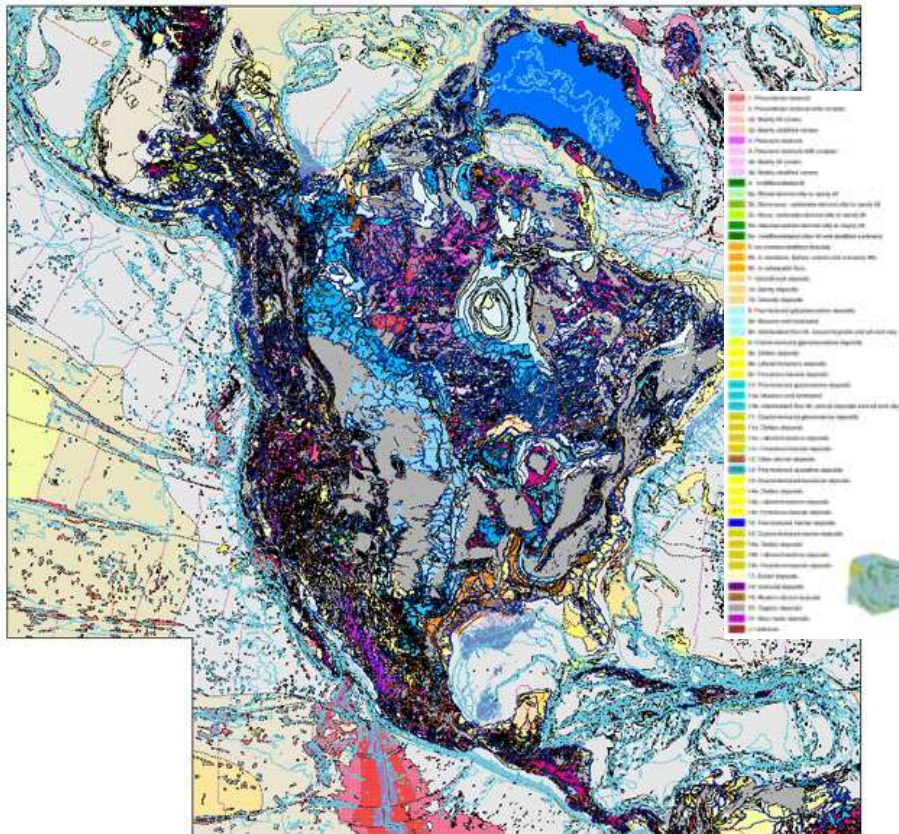


# Next, soil mapping by agricultural agencies





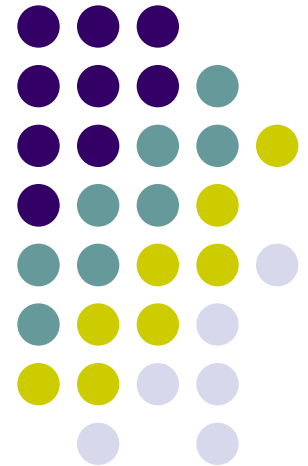
# Then, geology



# **Geological mapping, like all of the mapping we do, is an essential service**

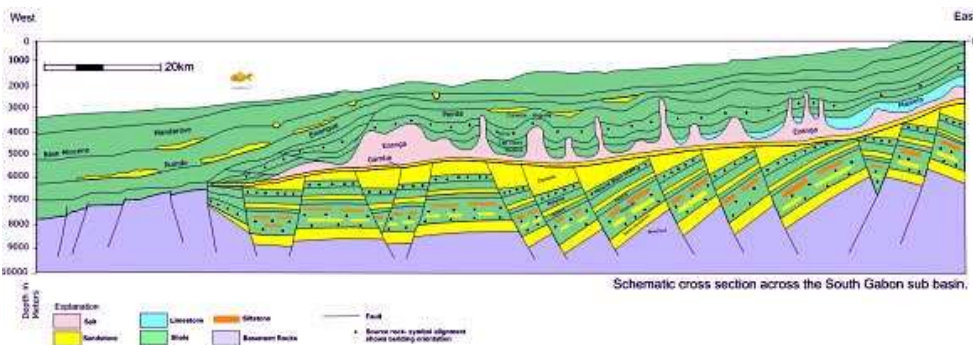
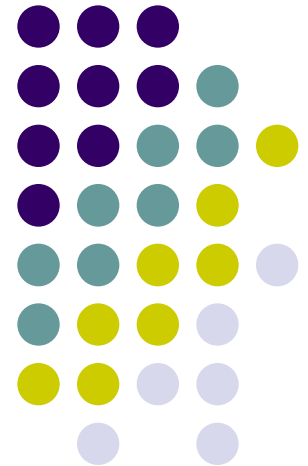


**Energy  
Minerals  
Water  
Hazards  
Environment  
Waste  
Engineering**



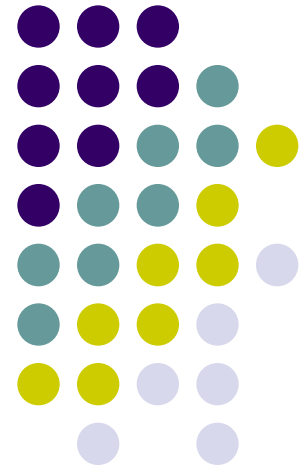
# Geological mapping, like all of the mapping we do, saves money

**lives saved**  
**resources discovered**  
**costs avoided**  
**increased efficiency**  
**fundamental**  
**understanding**



# **We need to accelerate in response to societal needs**

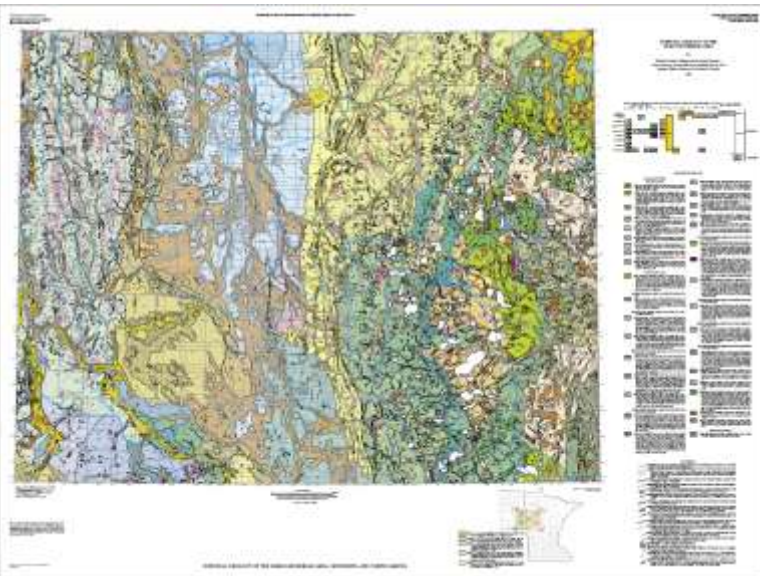
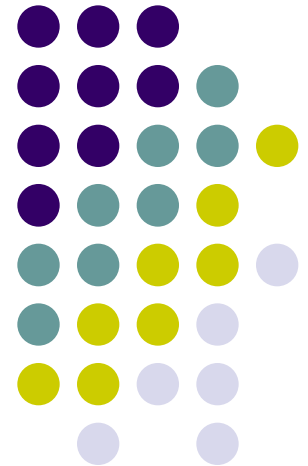
**Content**  
**Collaboration**  
**Administration**  
**Infrastructure**  
**Formats**  
**Accessibility**





# **Paper maps and their digital equivalents will continue to be our foundation**

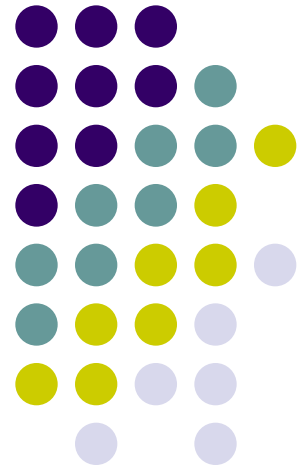
**information content is rich  
standards well-developed  
formats are familiar  
usable indefinitely  
authorship  
peer review**





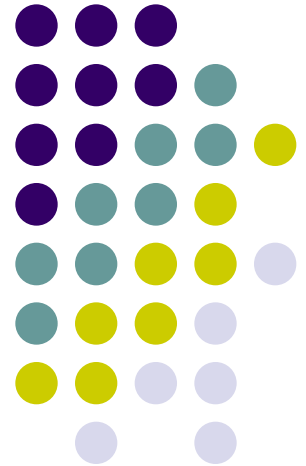
# Ongoing geological mapping will be supported by

*new drilling,  
geochronology,  
geochemistry,  
geophysics, &  
data compilation*

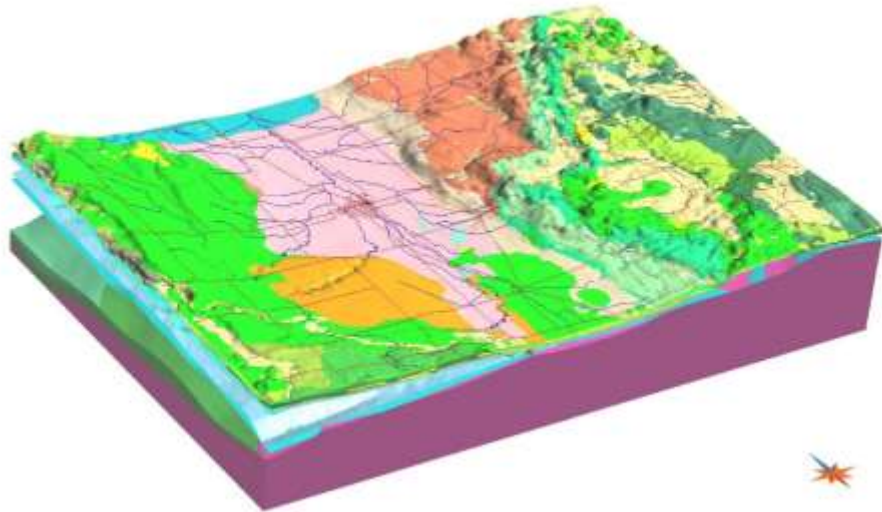


**All geological mapping  
will be vertically  
georeferenced using the  
best available**

***topography,  
bathymetry,  
drillhole data, &  
geophysical surveys***

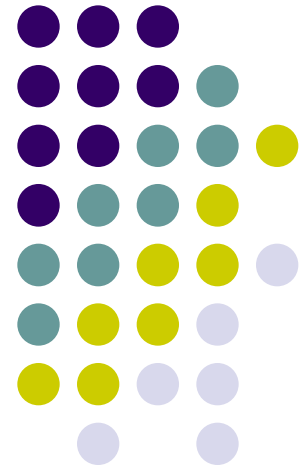


# **Future geological mapping needs to be**

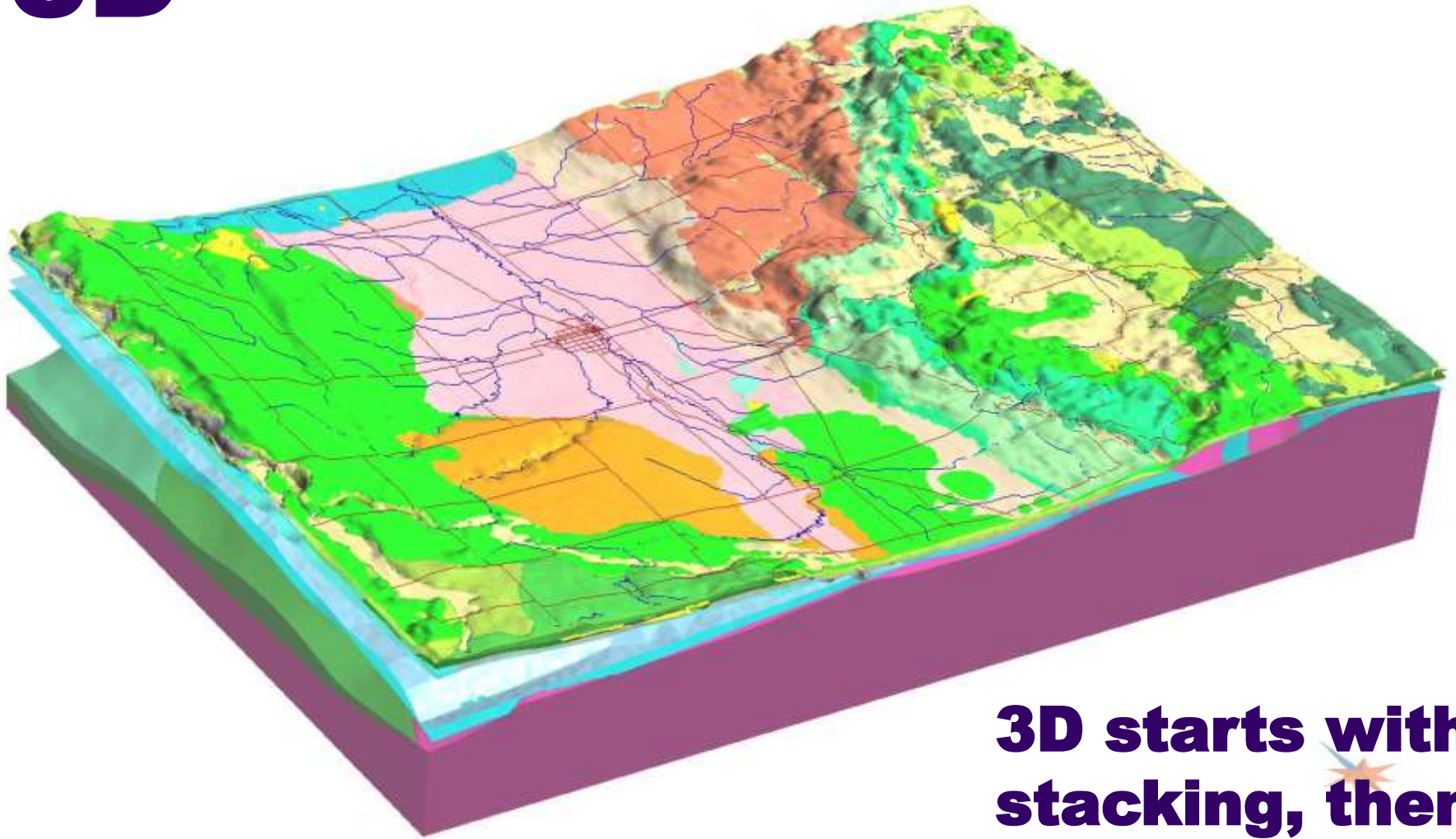


**Regularly updated  
Zoomable  
Queryable  
Complete  
Seamless  
3D**

**Onshore to offshore**



# 3D



**3D starts with  
stacking, then  
thickness**





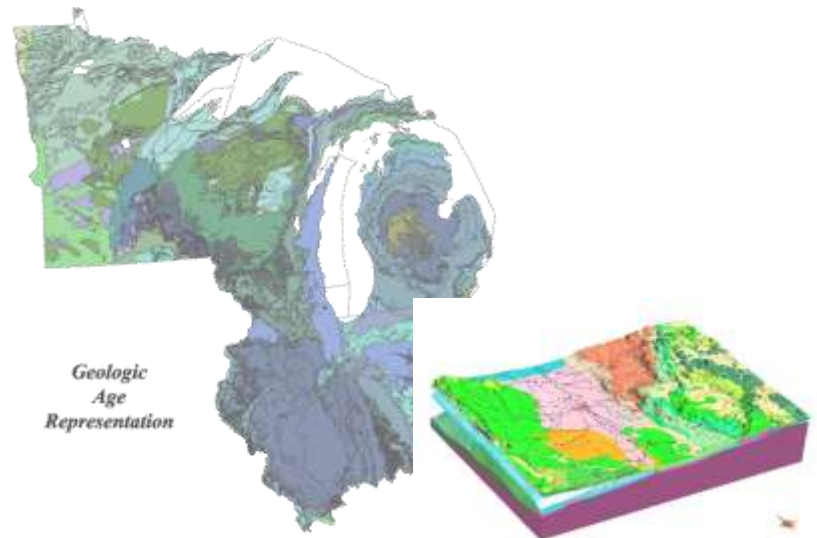
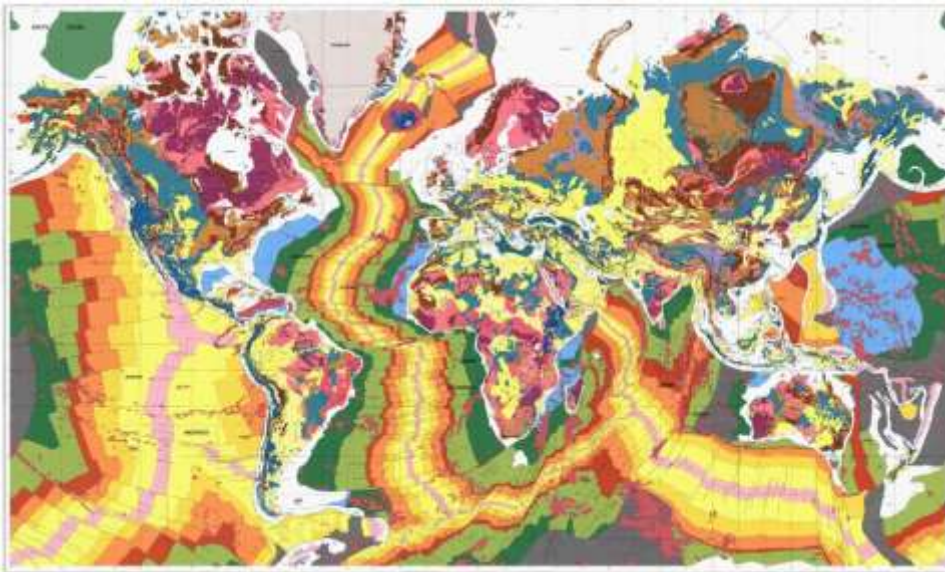
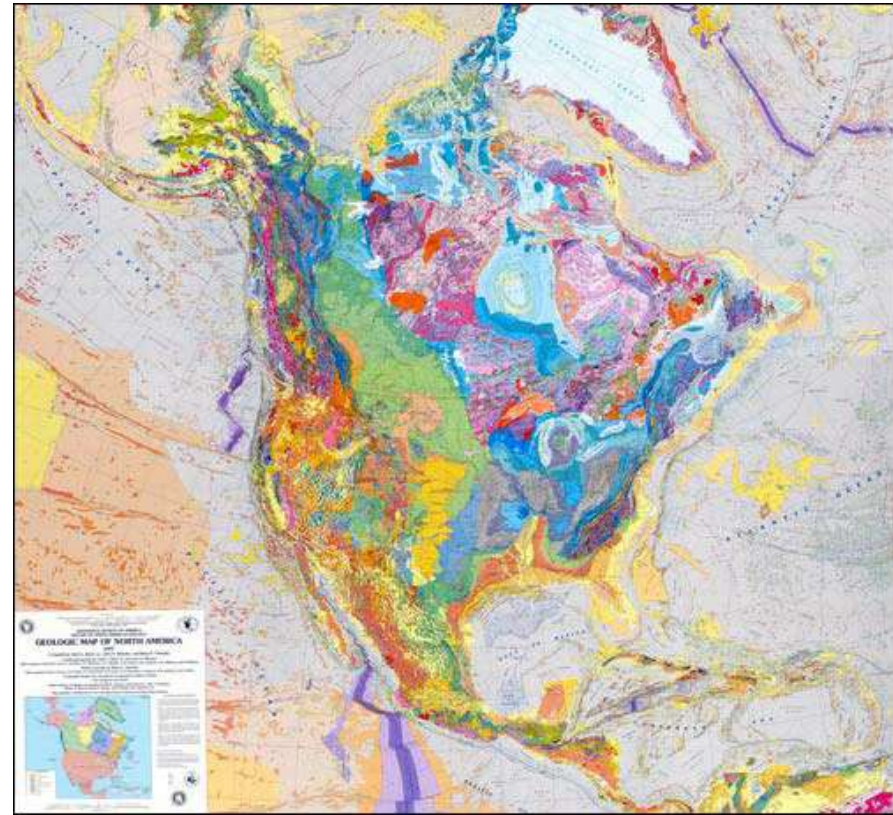
# Resolution

**Global**

**Continental**

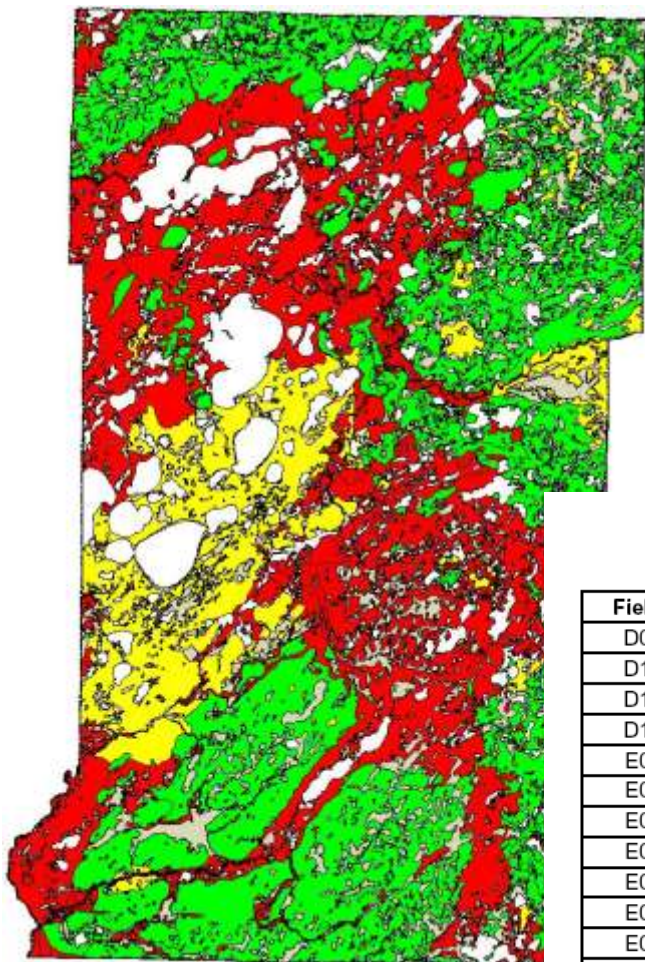
**Regional**

**Local**





# Linked



Appendix. Geochemistry of the <63 micron fraction

Field	Lab	Ag_ppm	Al_%	As_ppm	Au_ppb	Ba_ppm	Be_ppm	Bi_ppm	Ca_%	Cd_ppm	Ce_ppm	Co_ppm
D09	139	0.16	6.10	10.9	25	620	1.30	0.22	4.65	0.32	59.8	11.7
D10	127	0.13	5.11	7.7	0.5	400	1.30	0.19	4.02	0.38	70.9	11.0
D11	39	0.15	6.41	8.8	0.5	320	1.55	0.27	4.15	0.28	75.7	7.4
D12	225	0.13	6.57	13.6	1	480	1.50	0.25	1.62	0.34	86.1	11.6
E02	92	0.14	5.76	12.5	7	400	1.44	0.23	7.83	0.54	60.4	9.2
E03	190	0.14	5.16	13.4	0.5	390	1.32	0.27	9.55	0.65	65.2	10.8
E04	186	0.20	5.84	18.2	0.5	500	1.46	0.32	6.61	0.91	72.3	10.6
E05	61	0.10	4.24	11.0	2	520	0.93	0.16	4.09	0.28	52.0	8.5
E06	12	0.14	6.15	9.0	1	690	1.18	0.24	5.19	0.34	63.4	11.4
E07	195	0.11	4.56	7.5	0.5	460	1.12	0.18	5.20	0.40	51.8	9.6
E08	113	0.13	5.52	12.3	3	610	1.18	0.21	4.87	0.31	56.5	11.0
E09	181	0.13	5.30	5.2	7	520	1.26	0.20	5.39	0.34	64.4	11.4
E10	101	0.04	6.91	6.2	2	400	1.66	0.20	2.63	0.09	72.5	10.0
E11	167	0.15	7.34	9.0	0.5	420	2.03	0.26	4.18	0.32	91.4	15.3
F02	185	0.17	5.68	10.0	0.5	440	1.48	0.34	8.66	1.13	75.8	10.8
F03	198	0.19	5.64	14.6	3	550	1.28	0.31	6.94	0.66	66.8	12.4

Fly To

e.g., Rio de Janeiro  
Brightont. ☒ Brighton, UK

## ▼ Places

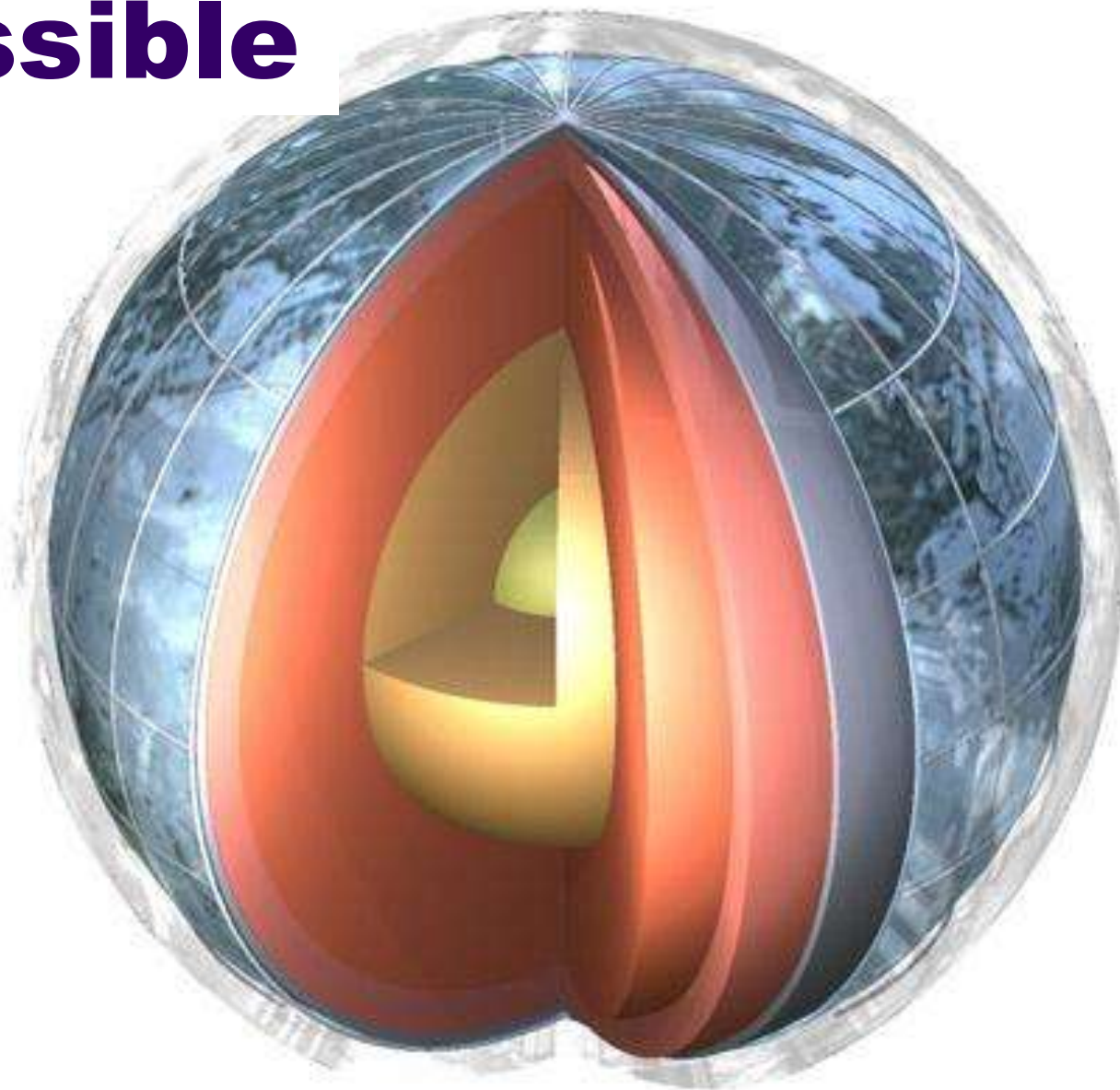
- ☒ My Places
- ☐ AAFC
- ☒ Harvey Thorleifson's Workout on 12/10/2006

## ▼ Layers

View: Core

- ☒ Primary Database
- ☐ Terrain
- ☐ Geographic Web
- ☐ Featured Content
- ☐ 3D Buildings
- ☐ roads
- ☐ borders
- ☐ Populated Places
- ☐ Alternative Place Names
- ☐ Dining
- ☐ Lodging
- ☐ Google Earth Community
- ☐ Shopping and Services
- ☐ Transportation
- ☐ Geographic Features
- ☐ Travel and Tourism
- ☐ Parks and Recreation Areas
- ☐ Community Services
- ☐ US Government
- ☐ Digital Globe Coverage

# Accessible



Google™

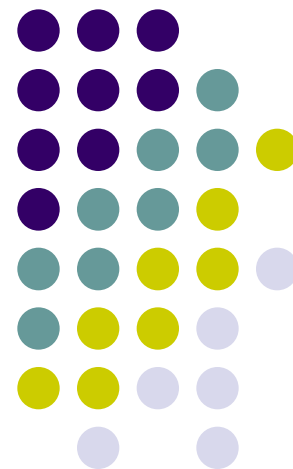
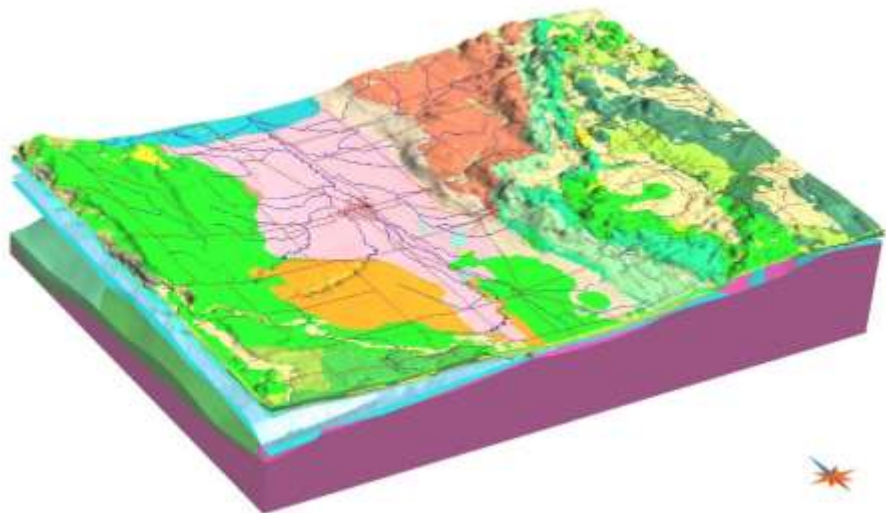
Eye alt 6852.55 mi

Pointer



# Future geological mapping needs to be

*Well-coordinated*





## National Cooperative Geologic Mapping Program

[Home](#) [About](#) [Program Components](#) [What's a Geologic Map?](#) [Geologic Map Database](#) [Products-Standards](#) [Contacts](#)

### Highlights

#### Best Student Geologic Map Competition

Inaugural Best Student Geologic Map Competition to be held on Tuesday, October 29, 2013 at GSA in Denver, CO. For more details, please go [here](#).

#### NCGMP Scientist Receives Presidential Honors

NCGMP FEDMAP Project Chief **Joseph Colgan** is a recent recipient of the **Presidential Early Career Award for Scientists and Engineers** (PECASE). More details at the [USGS Newsroom](#). Congratulations, Joel!

#### Celebrating Geologic Map Day 2013

As part of [Earth Science Week](#), the second annual [Geologic Map Day](#) will be celebrated on **October 18, 2013**. Brought to you by the [American Geosciences Institute](#) (AGI), the [American](#)

## National Cooperative Geologic Mapping Program



The **National Cooperative Geologic Mapping Program** (NCGMP) is the primary source of funds for the production of geologic maps in the United States and provides accurate geologic maps and three-dimensional framework models that help to sustain and improve the quality of life and economic vitality of the Nation and to mitigate natural hazards.

The NCGMP represents over 2 decades of successful cooperation among Federal (FEDMAP), State (STATEMAP), and university (EDMAP) partners to deliver digital geologic maps to customers. Each of these three

components has a unique role, yet all work cooperatively to select and map high-priority areas for new geologic maps.

Geologic mapping data from all of North America are presented via the National Geologic Map Database, and a common set of geologic map standards is being developed by the NCGMP in cooperation with the North American Geologic Map Data Model Steering Committee.

The USGS National Cooperative Geologic Mapping Program is congressionally mandated by the National Geologic Mapping Act of 1982.



Please join us at the Inaugural Best Student Geologic Map Competition. The competition, hosted by the USGS NCGMP, is a geologic mapping science competition for students from the United States (GSA) with sponsorship from the GSA Foundation, Association of American State Geologists (AASG), American Geosciences Institute (AGI), American Institute of Professional Geologists (AIPG), and the *Journal of Maps* will bring



Geoscience resource for maps and related information about geology, natural hazards, earth resources, geophysics, paleontology, marine geology, and more.

### Related Information

#### NCGMP Science Centers:

[Geology, Minerals, Energy, and Geophysics](#)

[Geosciences and Environmental Change](#)

[Eastern Geology and Geophysics](#)

**Geological mapping in the US is coordinated by the National Cooperative Geologic Mapping Program (NCGMP)**

# National Cooperative Geologic Mapping Program (NCGMP)

The National Cooperative Geologic Mapping Program was mandated by the National Geologic Mapping Act of 1992 and its reauthorizations of 1997, 1999, and 2009.

Planning and inception of the program was a joint effort of the USGS and the Association of American State Geologists (AASG)

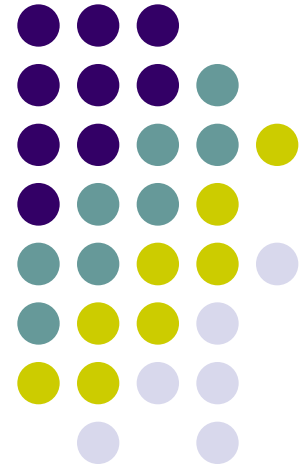
The Program includes:

**FEDMAP** - Funds Federal geologic mapping projects.

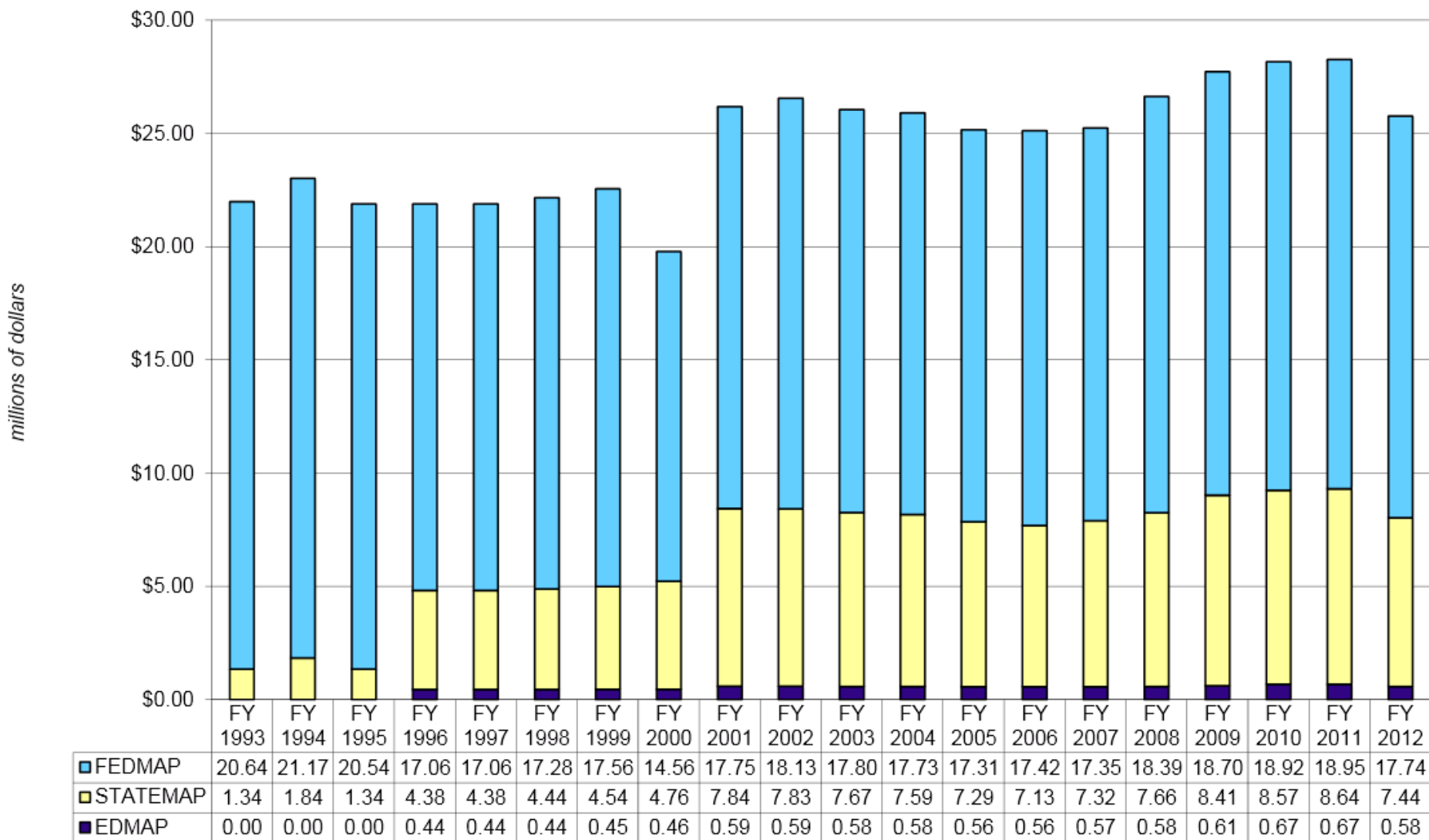
**STATEMAP** - A matching-funds grant program with State geological surveys

**EDMAP** - A matching-funds grant program for training new mappers

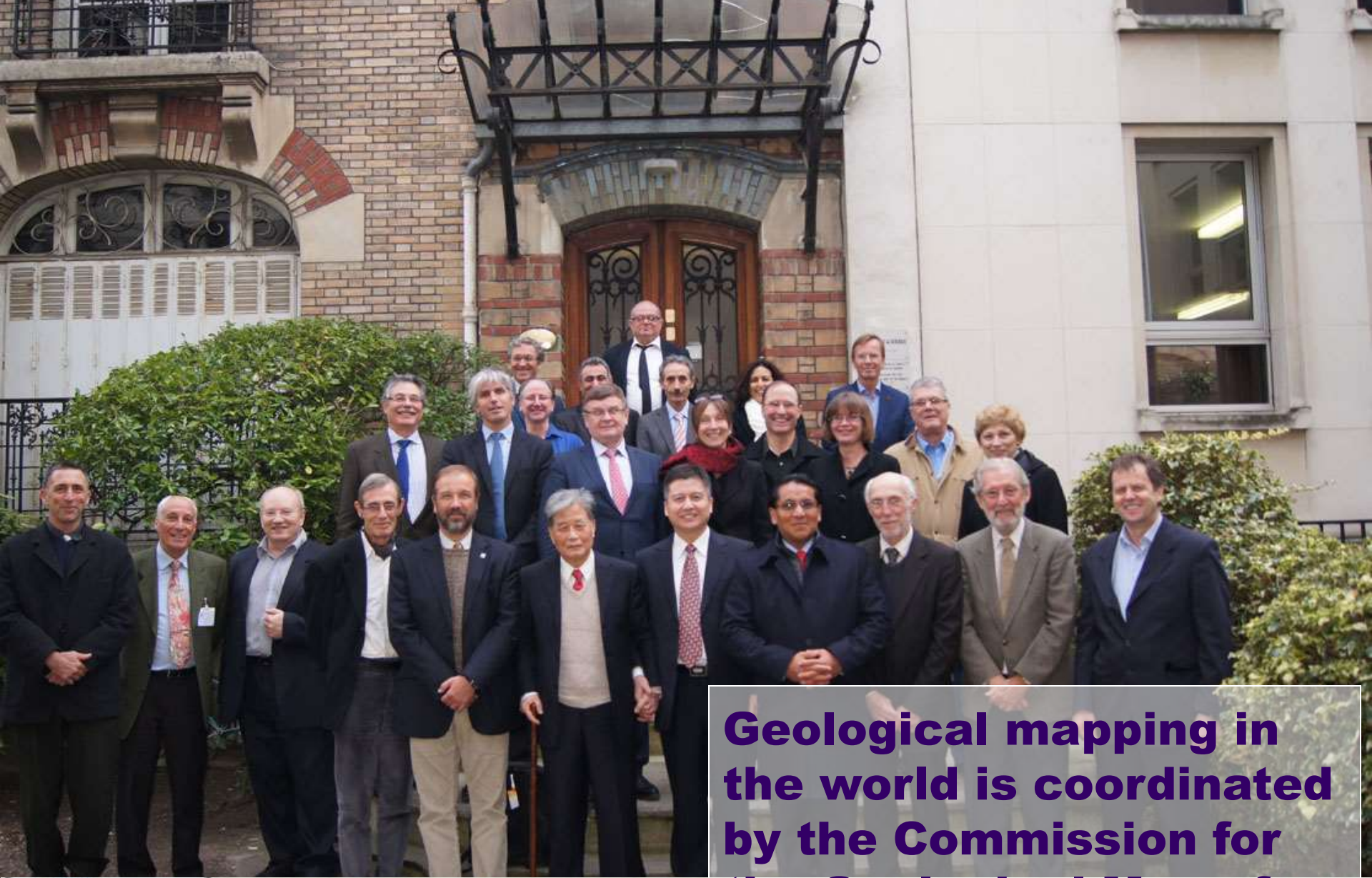
2014 Actual & 2015 Enacted - \$24,397M



# National Cooperative Geologic Mapping Program — Funding 1993 - 2012







**Geological mapping in  
the world is coordinated  
by the Commission for  
the Geological Map of  
the World (CGMW)**



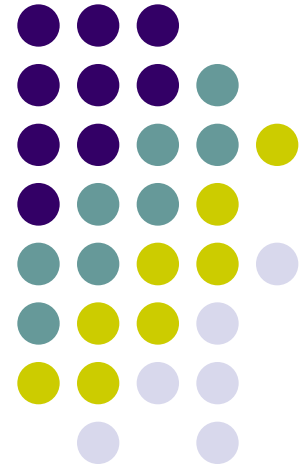
COMMISSION FOR THE GEOLOGICAL MAP OF THE WORLD

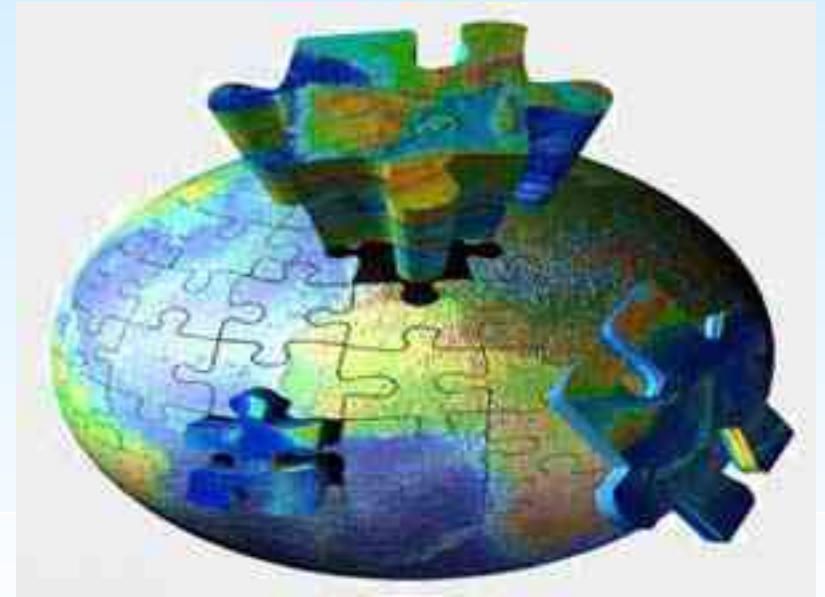


# **Commission for the Geological Map of the World (CGMW)**

**The CGMW is an international non-profit association governed by French law and is responsible for designing, coordinating, preparing and publishing small-scale thematic Earth Science maps of the globe, continent, major regions and oceans.**

**The CGMW is affiliated to the International Union of Geological Sciences (IUGS) and the International Union of Geodesy and Geophysics (IUGG), and is supported by UNESCO.**





**Geological mapping  
accessibility is  
coordinated by  
OneGeology**

# OneGeology

**OneGeology is an international initiative of the geological surveys of the world.**

**The Objectives of OneGeology are:**

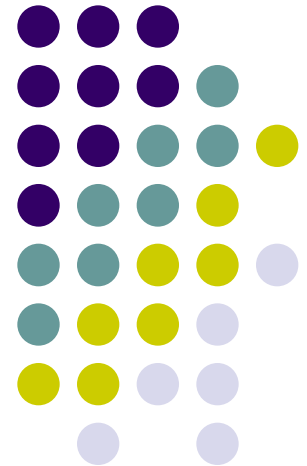
**To be the provider of geoscience data globally;**

**To ensure an exchange know-how and skills so all can participate;**

**Use of the global profile of OneGeology to increase awareness of the geosciences and their relevance.**

**OneGeology mission:**

**'Make web-accessible the best available geological map and other geoscience data worldwide at the best possible scales, starting with at least 1:1 million scale.'**



# International coordination of 3D geological mapping

***Harvey Thorleifson Ph.D., P.Geo, D.Sc.***  
***Director, Minnesota Geological Survey***  
***Mapping Chair, Association of American State  
Geologists***

**National Geospatial Advisory Committee**  
**September 1-2, 2015**

